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Remote Sensing and Machine Learning-Based Disaster Risk Assessment on Agricultural Land Use in Onshore Regions of Bangladesh Delta Affected by Recurrent Tropical Cyclones — Bulbul, Amphan, and Sitrang

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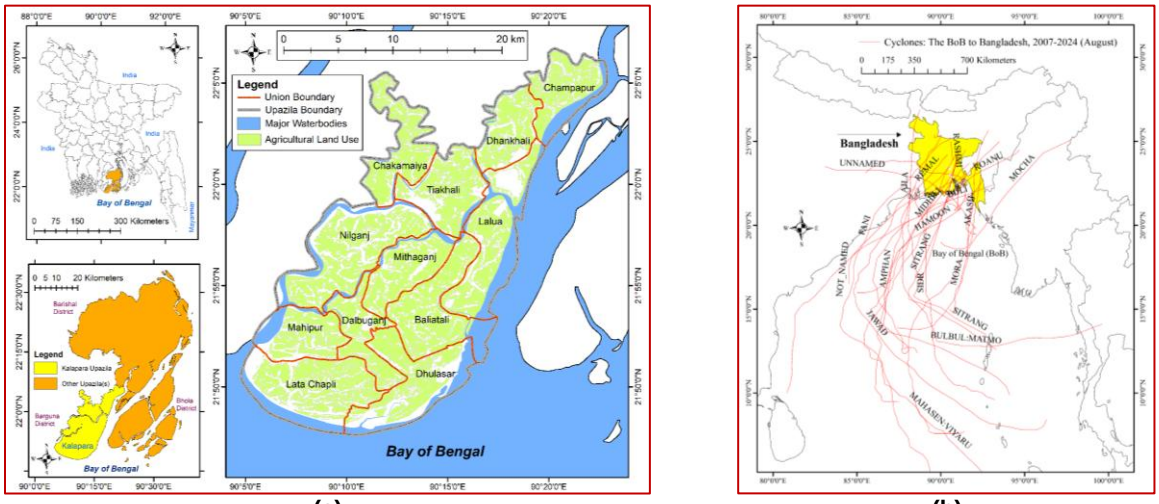
Extended Abstract

In Bangladesh delta's coastal regions, tropical cyclones cause harm to rice crops growing on agricultural lands almost every year. Therefore, utilizing remote sensing (RS) and machine learning (ML) technologies, this study addressed cyclones as climate-induced extreme events (42%) caused the most damage and were determined to occur most frequently in the last 46 years in the delta [1]. Among five compiled studies, the first research used tasseled cap transformation (TCT) from Landsat-derived RS datasets to measure shoreline changes throughout the delta's total onshore areas. It was discovered that in 1991, 2006, and 2021, respectively, 34.03%, 34.47%, and 33.52% of the area was used for farming agriculture. The study found that this delta's agricultural fields were extremely vulnerable to loss owing to coastal erosion processes and tropical cyclone (TC) landfalls respectively [2,3]. In the second study, changes were assessed based on TC Sitrang's landfall on 24th October 2022, and a machine learning system was used for rice crop change detection (CD) from TC Bulbul's landfall on 9th November 2019 in the Patuakhali district. Based on the CD classes moderately (26.07%), very (48.83%), and highly (17.73%) changed detected results showed damage to the transplanted Aman rice crop through machine learning techniques [4]. In the third study, a Bay of Bengal (BoB) adjacent Kalapara subdistrict under the Patuakhali district underwent a micro-scale damaged area assessment (DAA) for rice-farmed agricultural lands devastated by Bulbul [5]. Therefore, the fourth research was conducted in all administrative unions of the Kalapara subdistrict by developing the novel damaged area index (DAI) induced by the combined impacts of two recurrent cyclones Bulbul and Amphan. The TC Bulbul was selected from the 1st session of October-November (2019) and the TC Amphan was selected from the 2nd session of April-May (2020) duration of the said hazard-crop calendar respectively. The recurrent observations revealed that TC Bulbul caused greater damage than TC Amphan, which landed on 20th May 2020. The major DAI were reclassified among the DAI-6th to 9th ranked areas as 21.70%, 27.13%, 22.79%, and 2.92% due to the

joint recurrent impacts accordingly [6]. Therefore, in the fifth study, rice yield losses estimated from normalized difference vegetation index (NDVI) were classified in the sub-district as 1.5% marginal, 8.6% slightly, 38.2% moderately, 18.8% very, and 32.9% extremely loss areas using an overlay gamma-based fuzzy system [7]. The novel DAA, DAI, and fuzzy approaches for yield loss-based area calculations were introduced as disaster risk assessment results affected by cyclones. Furthermore, a new approach for estimating rice yield loss is provided with field validation for prompt action to assist emergency response needed-coastal farmers in the often-afflicted TC-prone regions.



(a) (b)

Figure 1: (a) Agricultural land use of the Kalapara subdistrict for the damaged area assessment, and (b) Recent cyclone outbreaks to Bangladesh 2007-2024.

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